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Final Technical Report for NASA Grant NAG 5-2527

Young Stellar Objects in the L1551 Star Forming Cloud

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June 6, 1996

Complementary soft and hard X-ray imaging observations of a nearby site of low mass star formation were made using the ROSAT and ASCA satellite observatories in order to study magnetically active young stars. The L1551 cloud in the Taurus-Auriga complex is one of the best-studied star forming regions at many wavelengths, and was the location where X-ray emitting T Tauri stars were first discovered with the Einstein Observatory. Our observation with the ROSAT PSPC detector reveal 38 faint soft X-ray sources. 2-3 are associated with classical T Tauri (CTT) stars, 5-7 with previously known weak-lined T Tauri (WTT) stars, 2-7 with new T Tauri stars, 1 with the B9e star HD 28867, 3 with no information to make a determination, and 21 with stars (often foreground Hyads) or extragalactic objects unrelated to the cloud. Twenty-four of the proposed identifications have Reliability Class 1, and are very likely to be correct. The ASCA GIS and SIS images showed seven X-ray sources in a smaller field of view, all clearly associated with prominent ROSAT sources. Five are produced by well-known CTT or WTT stars, one is unrelated to the cloud, and one is HD 28867. Since the ASCA pointing was centered on the cloud, nearly all of the sources are cloud members.

For each X-ray source, we have spectral and temporal information that elucidate its astrophysical nature. Spectral fitting of the brighter X-ray emitting stars suggests the emission is produced in either a multi-temperature plasma, with temperatures near 0.2 and 1 keV, or a single-temperature plasma with low metal abundances. XZ Tau, a very young and active CTT star, is much stronger in ASCA than ROSAT observations showing a harder (1.5-2.0 keV) component. Timing analysis reveals all but one of the T Tauri stars are variable on timescales ranging from one hour to a year. A powerful flare, emitting 3×10^{34} ergs within a 40 minute rise and fall, was observed by ASCA on the WTT star V826 Tau. The event was preceeded and followed by constant quiescent X-ray emission. The extreme CTT star XZ Tau was also caught during both high and low states. Neither of the luminous infrared embedded protostars L1551-IRS 5 or L1551NE were detected by ROSAT or ASCA, which may be due to heavy obscuration by the circumstellar disk.

A complete report of this study appears in the paper 'X-ray Emitting T Tauri Stars in the L1551 Cloud' by Lee Carkner, Eric D. Feigelson, Katsuji Koyama, Thierry Montmerle and I. Neill Reid. The paper is in press in the *Astrophysical Journal*, scheduled to appear in the June 10 1996 issue. The first author, Lee Carkner, is a Penn State graduate student. Katsuji Koyama, Professor of Physics at Kyoto University, is the Japanese collaborator. The collaboration between the PI and Prof. Koyama initiated by this grant is continuing in related studies of X-rays from T Tauri and protostars.